DESCRIPTION OF TWO NEW *CLARIAS* SPECIES FROM BORNEO (SILURIFORMES, CLARIIDAE)

by

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ABSTRACT. - *Clarias pseudoleiacanthus* sp. nov. is described from Borneo (Kalimantan, Indonesia). The new species is distinguished from all other Southeast Asian *Clarias* species by the combination of the following characters: a short distance between the occipital process and the base of the first dorsal fin ray (4.5-5.6% SL), a very short occipital process with a broad and rounded tip (length: 5.7-8.0% HL), the anterior edge of the pectoral spine smooth and without serrae, 17-19 gill rakers on the first branchial arch, and a relatively short anal fin compared to *C. nieuhofii* (48.4-54.4 *vs*. 59.7-66.8% SL) with 55-57 rays. *Clarias kapuasensis* sp.nov. is described from the upper part of the River Kapuas (Western Kalimantan, Borneo, Indonesia). The new species is distinguished from all other Southeast Asian *Clarias* species by the combination of the following characters: a very short occipital process with a broad and rounded tip (length: 5.2-6.6% HL), a relatively long distance between the tip of the occipital process and the dorsal fin origin (6.4-8.7% SL), the anterior edge of the pectoral spine smooth and without serrae, 21-22 gill rakers on the first branchial arch, and a relatively short anal fin compared to *C. nieuhofii* (48.7-53.1 *vs*. 59.7-66.8% SL) with 51-60 rays.

RÉSUMÉ. - Description de deux espèces nouvelles du genre *Clarias* de Bornéo.

Clarias pseudoleiacanthus sp. nov. est décrite en provenance de la partie indonésienne de Bornéo. Cette nouvelle espèce se distingue des autres espèces de *Clarias* d'Asie du Sud-Est par la combinaison des caractères suivants : une courte distance entre l'extrémité du processus occipital et la base du premier rayon dorsal (4.5-5.6% SL), un processus occipital très court et arrondi (5.7-8.0% HL), l'absence de serrations sur la face antérieure de l'épine pectorale, 17-19 branchiospines sur le premier arc branchial et une nageoire anale relativement courte comparée à *C. nieuhofii* (48.4-54.4 *vs*. 59.7-66.8% SL) avec 55-57 rayons. *Clarias kapuasensis* sp. nov. est décrite de la partie amont du fleuve Kapuas (Ouest Bornéo, Indonésie). Cette nouvelle espèce se distingue des autres espèces de *Clarias* d'Asie du Sud-Est par la combinaison des caractères suivants: un processus occipital très court de forme arrondie (5.2-6.6% HL), une longue distance entre l'extrémité du processus occipital et la base du premier rayon dorsal (6.4-8.7% SL), l'absence de serrations sur la face antérieure de l'épine pectorale, 21-22 branchiospines sur le premier arc branchial et une nageoire anale relativement courte comparée à *C. nieuhofii* (48.7-53.1 *vs*. 59.7-66.8% SL) avec 51-60 rayons.

Key word. - Clariidae - *Clarias pseudoleiacanthus* - *C. kapuasensis* - Indonesia - Borneo - Taxonomy - Morphology - New species.

Catfishes of the genus *Clarias* or walking catfishes occur naturally in Africa, Asia Minor, the Indian subcontinent, Southeast Asia, China and Japan. They are characterised by long dorsal and anal fins, no adipose fin, jaws bearing a band of villiform teeth and a band of villiform or granular teeth across the vomer, small eyes with a free orbital margin, eight barbels (one pair of nasal, one pair of maxillary, and two pairs of mandibular barbels), upper and lateral parts of the head osseous, or covered with only a very thin skin, an accessory branchial organ attached to the convex side of the second and fourth branchial arches and received in a cavity behind the gill-cavity proper, ventral fins six-rayed and only pectoral fins possess a spine (Günther, 1864). Boulenger (1901) added that the swimbladder in this genus is bilobed, disposed transversely and partially enclosed in a bony sheath formed by the transverse process of the fourth and fifth vertebrae.

Following Ng (1999), nine species were recognised as valid in Southeast Asia (including Thailand, Vietnam, Cambodia, Malaysia, Philippines and Indonesia), viz. *Clarias anfractus* Ng, 1999, *C. batrachus* (Linnaeus, 1758), *C. batu* Lim & Ng, 1999, *C. leiacanthus* Bleeker, 1851, *C. macrocephalus* Günther, 1864, *C. meladerma* Bleeker, 1846, *C. nieuhofii* Valenciennes, in Cuvier & Valenciennes,

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1840, *C. olivaceus* (Fowler, 1904) and *C. planiceps* (Ng, 1999). This author did not included *C. fuscus* (Lacepède, 1803), a Chinese taxon with one record from the Philippines (Fowler, 1941) probably based on a misidentification and one record from Sumatra (MNHN A-8939) following Valenciennes (1840) but presently identified as a specimen of *C. leiacanthus*. Nevertheless, we suggest to consider that this species belongs to the Southeast Asian *Clarias* as it also occurs in North Vietnam. Two new species, namely *C. microstomus* Ng, 2001 and *C. intermedius* Teugels *et al.*, 2001 were recently described and increased to 12 the number of *Clarias* species in Southeast Asia.

The diversity of inland fishes in Southeast Asia is very high, with about 1000 species known from western Indonesia and some 900 known from mainland Southeast Asia (Kottelat, 1998). Kottelat *et al.* (1993) indicated that Borneo displays the highest rate of endemicity for many freshwater families. In Borneo, catfishes constitute, together with the cyprinids, the most abundant component of the freshwater fish fauna, and they also tend to display an overwhelming rate of endemic species. This is particularly true for the Pangasiidae, with seven endemic species (Roberts, 1989; Roberts and Vidthayanon, 1991; Pouyaud and Teugels, 2000; Pouyaud *et al.*, 2002; Gustiano *et al.*, 2003). The Clariidae also display a considerable richness of species endemic to Borneo as shown by the recent description of three new species from the northern and the eastern parts of the island by Ng (1999, 2001) and one from the central region by Teugels *et al.* (2001).

During the last few years, several specimens of *Clarias* have been collected from the Kapuas River drainage (western Borneo) and from the Barito River drainage (southern Borneo). Comparison of these specimens with all other nominal species of Southeast Asian *Clarias* revealed the presence of two species with distinct characters. We therefore consider this material as representing two species new to science which are described herein.

MATERIALS AND METHODS

Thirty seven specimens representing the two new species were examined. They were deposited in the Musée Royal de l'Afrique Centrale, Tervuren (Belgium) (MRAC), the Muséum National d'Histoire Naturelle, Paris (France) (MNHN), the Zoological Reference Collection, Singapore (ZRC) and the Museum Zoologicum Bogoriense, Cibinong (Indonesia) (MZB). Comparative material consisted of the available type specimens of the *Clarias* species from Southeast Asia. It includes the holotype (ZRC 42598) and 2 paratypes (ZRC 43392) of *C. anfractus*; the holotype (ZRC 40087) and 7 paratypes (ZRC 40088) of *C. batu*; the holotype (BMNH 1863.12.4.55) of *C. leiacanthus* and its junior synonyms (cf. Ng, 1999) with the holotype (RMNH 6803) of *C. teijsmanni* Bleeker, 1857, the holotype (ANSP 64862) of *C. cataractus* Fowler, 1939, the holotype (RMNH 7542) of *C. pulcher* Popta, 1904 and 3 syntypes (ZMB 20944-20931) of *C. thienemanni* Ahl, 1934; the lectotype (BMNH 1862.11.1.216) and the paralectotype (BMNH 1862.11.1.217) of *C. macrocephalus* (see Teugels *et al.*, 1999), the holotype (MZB 10574) and 18 paratypes (ZRC 46110-113, MNHN 2000-1212-1213, MNHN 2000-1214-1219, MRAC 96-050-P-120-121, MRAC 96-050-P-129-132) of *C. intermedius* Teugels *et al.*, 2001; the lectotype (RMNH 13709) and 2 paralectotypes (BMNH 1862.2.4.8, BMNH 1880.4.21.201) of *C. meladerma*; the syntype (RMNH 16413) of *C. melasoma* Bleeker, 1852, a junior synonym of *C. meladerma* (cf. Teugels *et al.*, 2001); the holotype (ANSP 27280) and three paratypes (ANSP 27281) of *C. olivaceus*; the holotype (MNHN B300) of *C. nieuhofii*; the holotype (USNM 55620) of *C. gilli* Smith & Seale, 1906, a junior synonym of *C. nieuhofii* (cf. Bleeker, 1858; Weber & de Beaufort, 1913; Fowler, 1941); the holotype (SMK uncat.) and 5 paratypes (ZRC 42543, 45544, 37800, 37809, 37820) of *C. planiceps*. It was not possible to study the type material of *C. fuscus* and *C. batrachus* with its junior synonyms *C. punctatus* and *C. jagur* for which type specimens are lost. Following Teugels and Roberts (1987), the specimen (NRM 71) deposited in the Naturhistoriska Riksmuseet in Stockholm cannot be the holotype of *Silurus batrachus* but corresponds to a type specimen of *C. anguillaris* (Linné, 1758). We therefore studied the 2 syntypes (BMNH 1858.8.15.101-102) of *Clarias (= Macropteronotus) magur* (Hamilton, 1822) and 2 syntypes (MNHN B685) of *C. marpus* Valenciennes, in Cuvier & Valenciennes, 1840, two junior synonyms of *C. batrachus* following Bleeker (1858) and Günther (1864).

Additional material examined included around 500 *Clarias* specimens conspecific with all valid species from Southeast Asia and housed in different natural history museums. It also includes specimens from the type localities of *C. punctatus*, *C. fuscus*, *C. microstomus*, and *C. pentapterus* Bleeker, 1851 (a junior synonym of *C. nieuhofii* cf. Fowler, 1941). The list of specimens examined can be requested at the address of the senior author.

On each specimens, 30 measurements were taken point to point using dial calipers following Teugels *et al.* (2001). The following abbreviations are used: SL, standard length; HL, head length. Barbel length is measured from the base to the tip. Measurements of bilateral characters, such as pectoral spine length, pectoral and pelvic fin length, were made on the left side of the body. The following meristic counts were made: number of gill rakers on the complete first branchial arch, number of dorsal fin rays, number of anal fin rays and the number of serrae on the anterior side of the pectoral spine.

A principal component analysis (PCA) was carried out on the morphometric data using the CSS STATISTICA (StatSoft, Inc.) package, version 4.5. Measurements were log-transformed before the PCA was run on the covariance matrix (Bookstein *et al.,* 1985). The first factor of this analysis is considered as the size factor and was not taken into account in order to minimise the effect of size differences between the samples. Missing data were casewise deleted.

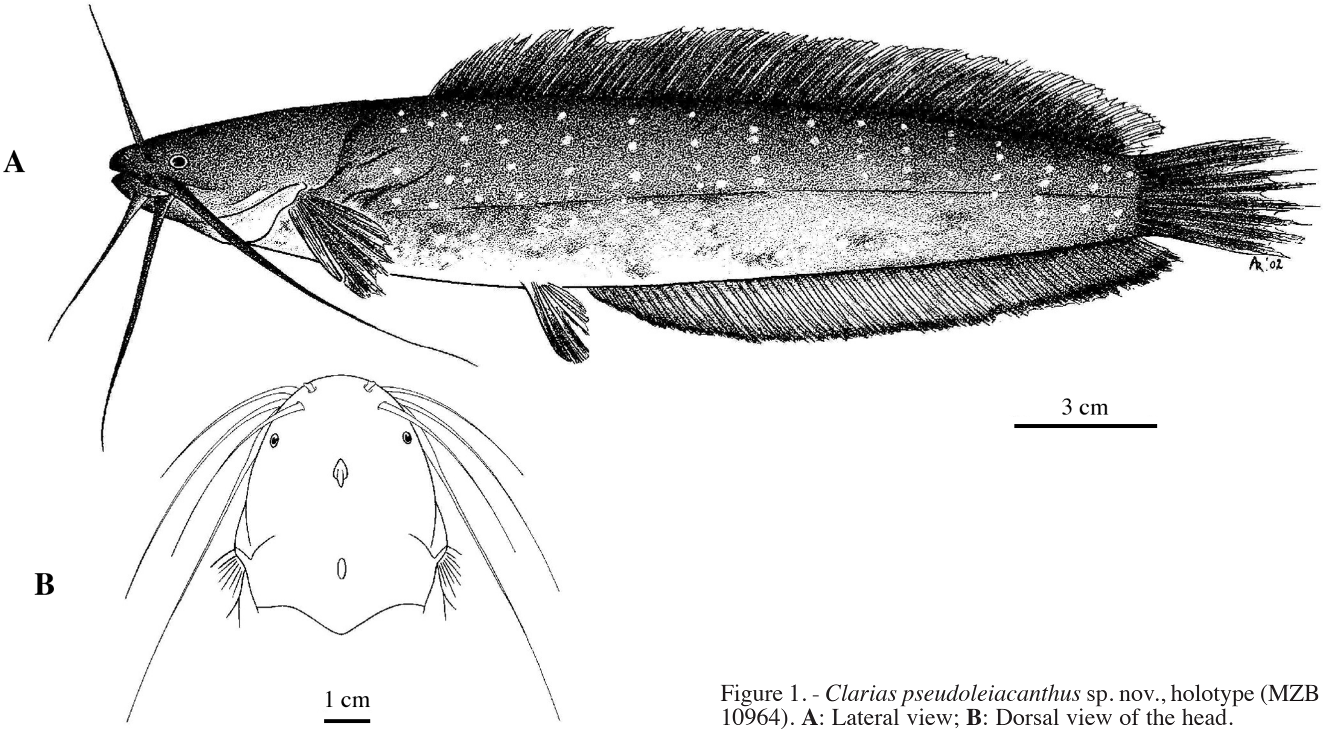

Figure 1. - *Clarias pseudoleiacanthus* sp. nov., holotype (MZB 10964). **A**: Lateral view; **B**: Dorsal view of the head.

Table I. - Measurements for the holotype and 15 paratypes of *Clarias pseudoleiacanthus* sp. nov.

	Holotype	Paratypes				
SL (mm)	220	160 - 245				
In % Standard length		N	Mean	Min.	Max.	SD
Maximal body depth	17.5	15	17.3	15.7	18.2	0.7
Caudal peduncle depth	7.7	15	7.7	7.1	8.6	0.4
Head length	25.0	15	24.7	23.6	26.0	0.7
Head width	17.5	15	18.0	17.3	18.7	0.5
Predorsal length	30.0	15	29.2	28.0	30.5	0.7
Preanal length	46.6	15	47.6	45.4	49.2	1.1
Prepelvic length	41.1	15	41.7	39.6	43.5	1.1
Prepectoral length	19.3	15	18.3	17.1	19.2	0.6
Dorsal fin length	72.3	15	71.1	69.0	73.7	1.3
Length between dorsal and caudal fin	-0.5	15	0.4	-1.2	1.1	0.8
Length between occipital process and dorsal fin	5.2	15	5.1	4.5	5.6	0.4
Pectoral spine length	9.2	15	10.4	8.7	11.9	0.8
Pectoral fin length	13.5	15	14.9	13.3	16.6	1.0
Pelvic fin length	9.9	15	10.0	9.1	11.6	0.7
Anal fin length	53.6	15	51.3	48.4	54.4	1.6
In % Head length		N	Mean	Min.	Max.	SD
Snout length	24.1	15	21.9	18.4	25.0	1.9
Interorbital width	46.1	15	44.4	41.1	47.4	1.6
Eye diameter	5.8	15	5.8	3.6	7.8	1.0
Occipital process length	6.7	15	6.9	5.7	8.0	0.7
Occipital process width	27.9	15	31.0	27.4	33.4	1.3
Frontal fontanelle length	13.2	15	15.9	12.6	20.3	2.1
Frontal fontanelle width	6.4	15	8.6	6.8	11.8	1.4
Premaxillary toothplate width	24.5	15	23.2	20.0	25.6	1.5
Vomerine toothplate width	26.3	15	25.6	24.4	28.1	1.1

RESULTS AND DISCUSSION

Clarias pseudoleiacanthus **sp. nov.** (Fig. 1 A-B)

Material examined

Holotype. - MZB 10964, 220 mm standard length, collected at Satong (peat swamp at about 30 km after Ketapang on the road to Sukadana), Borneo, West Kalimantan, Indonesia, coll. Sudarto and L. Pouyaud, Mar. 2000.

Paratypes. - ZRC 47145, 6 specimens, 175-245 mm SL, same data as the holotype; MNHN 2002-1284, 6 specimens, 176-232 mm SL, same data as the holotype; MRAC 2002-027-P-1-3, 3 specimens, 160-233 mm SL, collected in the peat swampy area around Palangkaraya, Borneo, Central Kalimantan, Indonesia, coll. W. Hadie, Aug. 1999.

Diagnosis

Clarias pseudoleiacanthus is distinguished from all other Southeast Asian *Clarias* species by the combination of the following characters: a short distance between the occipital process and the base of the first dorsal fin ray (4.5-5.6% SL), a very short occipital process length (5.7-8.0% HL), the anterior edge of the pectoral spine smooth and without serrae, 17-19 gill rakers on the first branchial arch, and a relatively short anal fin compared to *C. nieuhofii* (48.4-54.4 *vs.* 59.7-66.8% SL) with 55-57 rays.

Description

Based on the holotype and 15 paratypes. Measurements are given in table I.

Compared to other Southeast Asian *Clarias* species, the head in *C. pseudoleiacanthus* is short and broad and the snout is rounded in dorsal outline. The interorbital distance is more than two fifths of the head length. The eyes are very small and latero-dorsally placed. The frontal fontanelle is short and "sole-shaped" (Teugels, 1986), about twice as long than broad. Its anterior tip never reaches the virtual line between the posterior eye borders. The occipital fontanelle is small, oval-shaped and distantly set from the occipital process basis. The anterior tip of the occipital fontanelle is always situated posteriorly to the imaginary line connecting the basis of pectoral spines. The occipital process is very short and extremely rounded in all specimens examined; its length is equivalent to the eye diameter.

The barbels are well developed; the nasal and the inner mandibular barbels reach the base of pectoral spine; the maxillary and the outer mandibular barbels attain the level of the dorsal fin origin.

The toothplates are small; the vomerine width is always larger than the premaxillary width.

The dorsal fin origin is situated close to the tip of the occipital process and reaches the caudal fin. Both fins are clearly distinguished and no confluency is noted. There are 66 (holotype) dorsal fin rays. As in the dorsal fin, the anal fin reaches the caudal fin base, but they are not confluent. There are 55-57 (n = 3) anal fin rays. The anal fin base is situated closer to the tip of the snout than to the caudal fin base. The anal and dorsal fins are fleshy. The pelvic fins are long and reach the fifth anal fin rays. The pectoral fins are long and largely reach beyond the origin of the first dorsal fin rays. The pectoral spine is broad and covered with skin. Its anterior margin is smooth and no serrae are observed.

The lateral line is visible and its secondary openings can be seen as white spots, regularly placed on the upper side of the flanks.

The number of gill rakers on the complete branchial arch varies between 17 and 19 (n = 4) (18 for holotype).

Coloration

Live coloration is black on dorsal and lateral sides of head and body, fading to a paler colour on ventral surfaces. The fins and the lips are black. Regular small white or yellow spots are visible on upper and lower side of flanks. On the ventral borders these spots are smaller and more numerous than on the lateral borders.

Distribution

Known from the southern part of the mouth of the Kapuas River in western Kalimantan (Borneo, Indonesia) and in the coastal swampy area near the Barito River in southern Kalimantan (Borneo, Indonesia).

Habitat

Clarias pseudoleiacanthus inhabits peat swamps in coastal forest areas. The new species was caught together with *C. leiacanthus* and *C. nieuhofii* in West Kalimantan and with *C. meladerma*, *C. leiacanthus*, *C. intermedius* and *C. nieuhofii* in South Kalimantan.

Etymology

The name refers to its similar external morphology with *C. leiacanthus*: "*pseudo*" (= false); "*leios* (smooth); *acanthos* (spine)

Clarias kapuasensis **sp. nov.** (Fig. 2 A-B)

Material examined

Holotype. - MZB 10965, 210 mm standard length, collected at Nanga Pinoh in peat swamp bordering the river Melawi in the upper part of the Kapuas River, West Kalimantan, Indonesia, coll. Sudarto and L. Pouyaud, Mar. 2000.

Paratypes. - ZRC 47146, 9 specimens, 178-260 mm SL, same data as the holotype; MNHN 2002-1285, 3 specimens, 165-195 mm SL, same data as the holotype; MRAC 2002-027-P-4-7, 4 specimens, 135-200 mm SL, collected in the

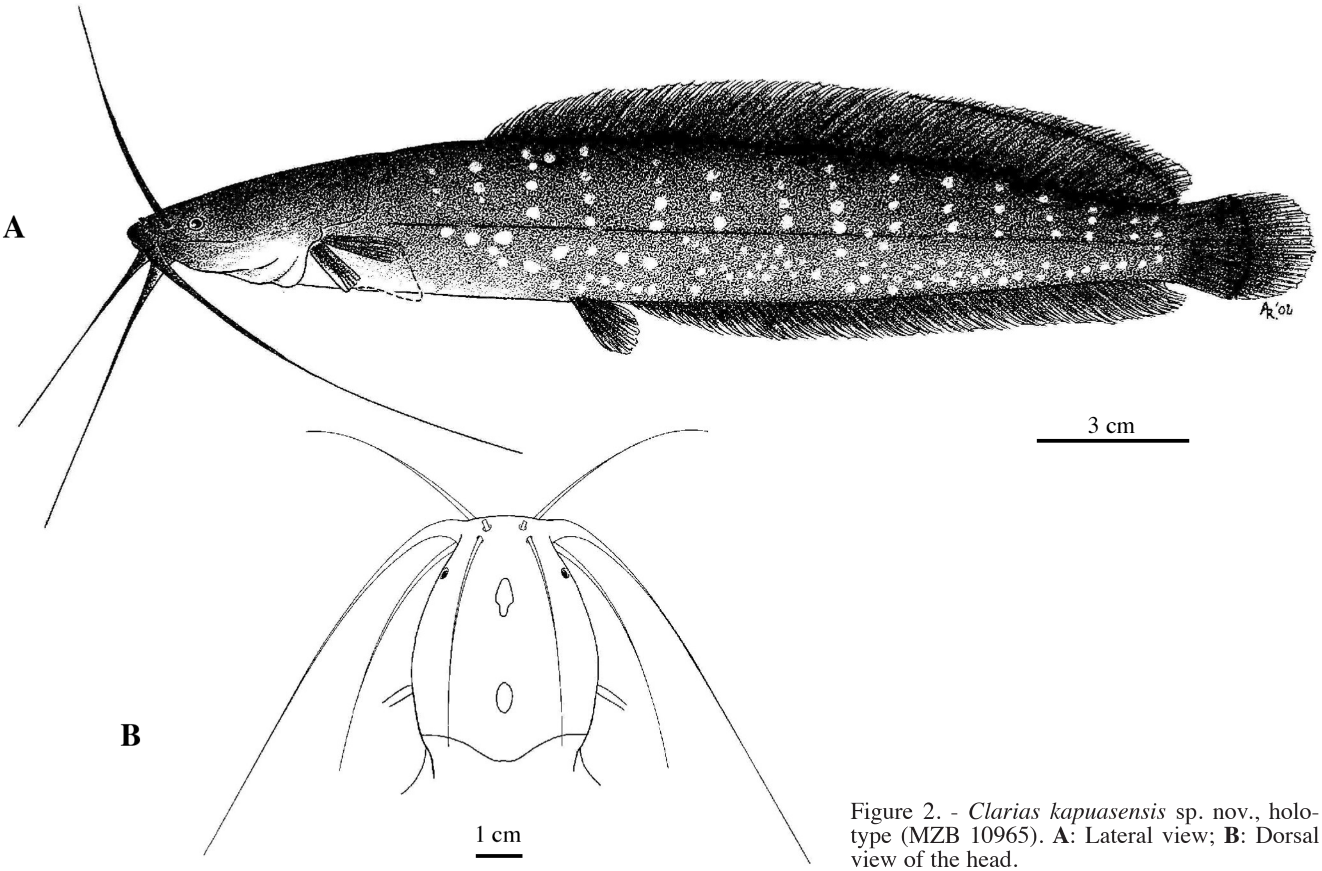

Figure 2. - *Clarias kapuasensis* sp. nov., holotype (MZB 10965). **A**: Lateral view; **B**: Dorsal view of the head.

Table II. - Measurements for the holotype and 20 paratypes of *Clarias kapuasensis* sp. nov.

	Holotype	Paratypes				
SL (mm)	210	135 - 260				
In % Standard length		N	Mean	Min.	Max.	SD
Maximal body depth	15.2	20	16.0	14.4	18.0	0.9
Caudal peduncle depth	6.7	20	7.0	6.2	8.1	0.4
Head length	24.8	20	24.8	23.3	25.9	0.8
Head width	17.6	20	18.1	16.9	18.8	0.5
Predorsal length	33.0	20	31.8	29.7	33.7	0.9
Preanal length	46.4	20	48.7	47.0	50.7	1.0
Prepelvic length	41.2	20	42.8	41.1	45.0	1.0
Prepectoral length	18.6	20	19.2	17.5	20.5	0.8
Dorsal fin length	66.0	20	68.0	64.4	70.5	1.7
Length between dorsal and caudal fin	1.4	9	1.5	1.2	1.7	0.2
Length between occipital process and dorsal fin	8.2	20	7.4	6.4	8.7	0.6
Pectoral spine length	6.2	20	8.3	6.5	9.9	0.8
Pectoral fin length	11.2	20	12.8	8.8	15.9	1.6
Pelvic fin length	7.6	20	8.9	7.8	9.6	0.5
Anal fin length	52.4	20	51.2	48.7	53.1	1.1
In % Head length		N	Mean	Min.	Max.	SD
Snout length	22.7	20	22.6	20.9	24.8	1.2
Interorbital width	44.2	20	44.4	42.5	48.7	1.4
Eye diameter	5.0	20	5.5	3.8	7.4	0.8
Occipital process length	5.4	20	6.0	5.2	6.6	0.4
Occipital process width	25.0	20	27.0	23.6	32.1	2.1
Frontal fontanelle length	13.5	20	16.1	11.1	19.1	2.3
Frontal fontanelle width	7.5	20	8.3	7.1	10.0	0.8
Premaxillary toothplate width	26.9	20	26.4	24.2	29.1	1.3
Vomerine toothplate width	24.0	20	24.7	22.2	27.4	1.4

swampy forest bordering the Sentarum Lake at the locality of Meliau, upstream of the Kapuas River, West Kalimantan, Indonesia, coll. Sudarto and L. Pouyaud, Mar. 2000; ZRC 47147, 4 specimens, 220-260 mm SL, collected near Sintang along the Kapuas River in peat swamp, West Kalimantan, Indonesia, coll. Sudarto and L. Pouyaud, Mar. 2000.

Diagnosis

Clarias kapuasensis is distinguished from all other Southeast Asian *Clarias* species by the combination of the following characters: a very short occipital process length (5.2-6.6% HL), a relatively long distance between the tip of the occipital process and the dorsal fin origin (6.4-8.7% SL), the anterior edge of the pectoral spine smooth and without serrae, 21-22 gill rakers on the first branchial arch, and a relatively short anal fin compared to *C. nieuhofii* (48.7-53.1 *vs*. 59.7-66.8% SL) with 51-60 rays.

Description

Based on the holotype and 20 paratypes. Measurements are given in table II.

Compared to other Southeast Asian *Clarias* species, the head in *C. kapuasensis* is short and oval-shaped in dorsal outline. The snout is somewhat pointed. The interorbital distance is about two fifths of the head length. The eyes are small and latero-dorsally placed. The frontal fontanelle is short and "sole-shaped", about twice as long as broad. Its anterior tip can reach the virtual line between the posterior border of the eyes. The occipital fontanelle is well developed, oval-shaped and distantly set from the occipital process basis. The anterior tip of the occipital fontanelle reaches the imaginary line connecting the basis of the pectoral spines. The occipital process is very short and rounded, its length equivalent to eye diameter.

The barbels are well developed; the nasal and the inner mandibular barbels reach the base of the pectoral spines; the maxillary and the outer mandibular barbels reach the dorsal fin origin.

The toothplates are large. The premaxillary toothplate is usually a little broader than the vomerine toothplate.

The dorsal fin origin is distantly set from the tip of the occipital process and reaches the caudal fin. Both fins are clearly distinguished and no confluency is noted. There are 65-72 (n = 4) dorsal fin rays (66 in holotype). The anal fin also reaches the caudal fin but is not confluent with the latter. There are 51-60 (n = 4) anal fin rays (60 in holotype). The anal fin base is situated closer to the tip of the snout than to the caudal fin base. The pelvic fin reaches the first or the second anal fin rays. The pectoral fins are short and extend to just before the dorsal fin origin. The pectoral spine is small and slender with a smooth anterior margin without serrae.

The lateral line is visible and its openings are visible as white or yellow spots, regularly placed on the upper side of the flanks.

The number of gill rakers on the complete branchial arch varies between 21 and 22 (n = 4) (21 for holotype).

Coloration

Live coloration varies from dark green to dark brown on dorsal surface of head and body, fading to greyish or whitish on ventral surface; dorsal and ventral fins greenish or brownish with a black margin. Big white or yellow spots are regularly placed along the flanks of the body.

Distribution

Known from the upper part of the Kapuas River (localities of Sintang, Nanga Pinoh and Meliau) West Borneo, Indonesia.

Habitat

Clarias kapuasensis inhabits swampy areas bordering the mainstream of the Kapuas River and its tributaries. *Clarias kapuasensis* was caught together with *C. leiacanthus* and *C. nieuhofii* in the localities of Nanga Pinoh and Meliau.

Etymology

Named after the Kapuas River Basin.

Definition and significance of artificial species-group within Southeast Asian *Clarias*

Ng (1999) proposed to categorise the Southeast Asian *Clarias* species into three artificial species-groups based on the number of dorsal-fin rays and on the distance between the tip of the occipital process and the base of the first dor-

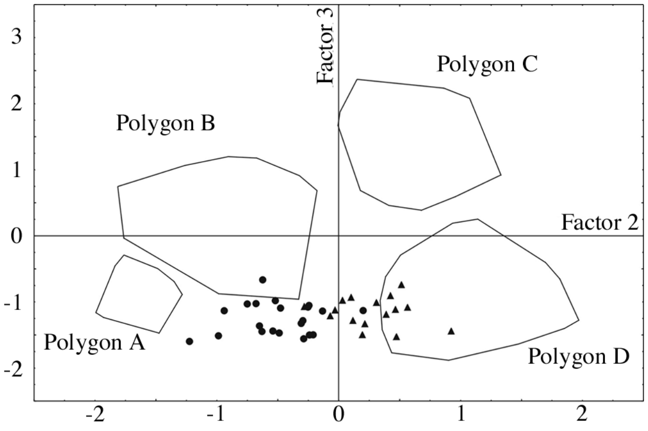

Figure 3. - Plot of the second and the third principal components of a PCA using 21 log-transformed measurements taken on 570 *Clarias* specimens from Southeast Asia. ● *C. kapuasensis* sp. nov.; ▲ *C. pseudoleiacanthus* sp. nov. See text for the species composition of each polygon.

sal-fin ray in order to simplify species comparisons. Following his conclusions, a first group characterised by a relatively short body with 60-76 dorsal-fin rays and an extremely short distance (2.1-4.7% SL) between the tip of the occipital process and the base of the first dorsal-fin ray was defined and included *C. macrocephalus*, *C. meladerma*, *C. fuscus* and *C. batrachus* with its junior synonyms *C. jagur*, *C. magur* and *C. punctatus*. A second group also characterised by a relatively short body, with 62-74 dorsal-fin rays, but possessing a longer distance (7.1-12.5% SL) between the tip of the occipital process and the base of the first dorsal-fin ray than the first group was also defined and included *C. batu*, *C. anfractus*, *C. planiceps*, *C. olivaceus* and *C. leiacanthus* with its junior synonyms *C. cataractus*, *C. teijsmanni*, *C. thienemanni* and *C. pulcher*. Finally, a third group composed of *C. nieuhofii* and its junior synonyms *C. gilli* and *C. pentapterus* was defined and differed in having a relatively long and slender body, with 87-106 dorsal-fin rays and a similar distance (6.6-9.3% SL) between the tip of the occipital process and the base of the first dorsal-fin ray as the second group.

Our results based on a larger sample size validated the third group proposed by Ng (1999) but also revealed that the distance between the tip of the occipital process and the base of the first dorsal-fin ray (OPDF) overlapped for some species included respectively in the first and the second group (i.e. OPDF between 3.8 and 7.5 % SL for *C. batrachus* with its junior synonyms, and between 5.9 and 11.1% SL for *C. leiacanthus* and its junior synonyms).

With the evidence that these two characters seem to be insufficient for categorising the Southeast Asian *Clarias* into distinct species-groups, we therefore propose to involve a larger set of characters. For that purpose, a principal component analysis was carried out using 21 log-transformed measurements [excluding total length, standard length, barbel lengths, eye diameter, length between dorsal and caudal fin, pectoral fin length] taken on 570 specimens. The plot of the second and the third factors of this PCA, explaining 2.8% of the total variation, is given in figure 3. The second factor is merely defined (in decreasing order of importance) by the distance between the occipital process and the dorsal fin, the frontal fontanelle length, the pectoral spine length, the pelvic fin length, the predorsal length and the anal fin length. The third factor is defined (in decreasing order of importance) by the occipital process length, the length and the width of the frontal fontanelle, the pectoral spine length and the vomerine width. The specimens analysed (except for the new species *C. pseudoleiacanthus* and *C. kapuasensis*) are segregated in four separated polygons corresponding to four distinct species-groups.

The first group (polygon A) is entirely situated on the negative sectors of both second and third factors on the PCA (Fig. 3). This group includes the holotype of *C. nieuhofii*, the holotype of its junior synonym *C. gilli*, 4 specimens from Banjarmasin (the type locality of *C. pentapterus* for which all types are lost), and 91 other specimens of *C. nieuhofii* sampled throughout Southeast Asia. This group corresponds to the third species-group defined by Ng (1999).

The second group (polygon B) is entirely situated on the negative sector of the second factor of the PCA (Fig. 3). It includes the type material of *C. olivaceus*, *C. anfractus*, *C. planiceps*, *C. batu*, *C. microstomus*, *C. leiacanthus* with its junior synonyms *C. teijsmanni*, *C. thienemanni*, *C. cataractus* and *C. pulcher* and conspecific material (105 specimens) of those species. This group corresponds to the second species-group proposed by Ng (1999).

The third group (polygon C) is entirely situated on the positive sectors of the second and the third factors of the PCA (Fig. 3) and includes all the material of *C. batrachus* with its junior synonyms *C. magur*, *C. marpus* and *C. punctatus* (142 specimens). This group also includes the material of *C. fuscus* with 4 specimens from China (the type locality of *C. fuscus* for which no types are known) and 3 specimens from North Vietnam.

The fourth group (polygon D) is entirely situated on the positive sector of the second factor and mostly on the negative sector of the third factor of the PCA (Fig. 3). It includes the type specimens of *C. meladerma* and its junior synonym *C. melasoma*, the lectotype and the paralectotype of *C. macrocephalus*, the type specimens of *C. intermedius*, and conspecific material of those species (129 specimens).

Both polygons C and D on the PCA (Fig. 3) correspond to the first species-group defined by Ng (1999). Before the discovery of the new species *C. pseudoleiacanthus* and *C. kapuasensis*, it would have been worth to confirm with the PCA (based on numerous morphological characters) the species-groups proposed by Ng (1999). Nevertheless, the intermediate position of the new species on the PCA between polygons A and B demonstrate the limits of such artificial grouping when the species diversity in a given taxon is underestimated. We therefore propose to present the affinities of both new species with all Southeast Asian *Clarias* species and not only with those from which they seem to display more morphological affinities.

Affinities between *C. pseudoleiacanthus* sp. nov., *C. kapuasensis* sp. nov., and the Southeast Asian *Clarias* species

Clarias pseudoleiacanthus and *C. kapuasensis* are distinguishable from *C. nieuhofii* and its junior synonyms *C. gilli* and *C. pentapterus* by a longer head length (23.3-26.0 *vs.* 16.7-21.1% SL), a larger head width (17.3-18.8 *vs.* 11.7-15.0% SL), a higher maximal body depth (14.4-18.2 *vs.* 9.7-14.3% SL), a higher caudal peduncle depth (6.2-8.6 *vs.* 3.3-5.7% SL), a longer preanal length (45.4-50.7 *vs.* 34.0-42.2% SL), a longer prepelvic length (39.6-45.0 *vs.* 30.9-

39.0% SL), a longer prepectoral length (17.1-20.5 *vs*. 13.0-16.3% SL), longer pelvic fins (7.6-11.6 *vs*. 3.8-6.3% SL) and a shorter anal fin (48.4-54.4 *vs*. 59.7-66.8% SL). *Clarias kapuasensis* possesses a shorter dorsal fin (64.4-70.5 *vs*. 72.3-81.1% SL) and a longer predorsal length (29.7-33.7 *vs*. 22.2-29.6% SL) than *C. nieuhofii*. *Clarias pseudoleiacanthus* is distinguishable from *C. nieuhofii* by a longer pectoral spine (8.7-11.9 *vs*. 3.8-7.7% SL) and a longer pectoral fin (13.3-16.6 *vs*. 6.3-10.8% SL). Finally, both new species possess fewer dorsal fin rays (65-72 *vs*. 82-105) and fewer anal fin rays (51-60 *vs*. 73-96) than *C. nieuhofii*.

Clarias pseudoleiacanthus and *C. kapuasensis* are distinguishable from *C. fuscus* and *C. batrachus* with its junior synonyms *C. punctatus*, *C. magur* and *C. marpus* by a shorter head length (23.3-26.0 *vs*. 26.1-30.9% SL) and a shorter occipital process length (5.2-8.0 *vs*. 9.1-19.3% HL). *Clarias pseudoleiacanthus* also possesses a broader vomerine tooth patch than *C. batrachus* and *C. fuscus* (24.4-28.1 *vs*. 15.2-24.1% HL), a shorter predorsal length (28.0-30.5 *vs*. 32.1-37.1% SL), a shorter preanal length (45.4-49.2 *vs*. 50.6-57.6% SL), and a shorter prepectoral length (17.1-19.3 *vs*. 19.4-24.3% SL) than *C. fuscus*. The number of serrae on the anterior side of the pectoral spine is the only meristic character which enables the recognition of *C. pseudoleiacanthus* and *C. kapuasensis* from *C. fuscus* and *C. batrachus*. The anterior side of the pectoral spine is smooth in both new species while it is marked by small and numerous serrae for the latter (28-50 serrae for *C. batrachus;* 17-23 serrae for *C. fuscus*).

Clarias pseudoleiacanthus and *C. kapuasensis* are distinguishable from *C. macrocephalus* by a shorter head length (23.3-26.0 *vs*. 26.3-30.4% SL), fewer gill rakers on the first branchial arch (17-22 *vs*. 27-33). The presence of 12-25 upward pointed serrae on the anterior side of the pectoral spine of *C. macrocephalus* also enables its recognition. *Clarias pseudoleiacanthus* possesses a higher caudal peduncle depth (7.1-8.6 *vs*. 4.6-6.7% SL), a broader vomerine tooth patch (24.4-28.1 *vs*. 18.4-23.4% HL), a shorter preanal length (45.4-49.2 *vs*. 49.4-54.0% SL), and a shorter prepectoral length (17.1-19.2 *vs*. 20.0-23.0% SL) than *C. macrocephalus*. *Clarias kapuasensis* is distinguished from *C. macrocephalus* by a longer distance between the tip of the occipital process to base of the first dorsal fin ray (6.4-8.7 *vs*. 2.2-5.1% SL) and a shorter pectoral spine length (6.2-9.9 *vs*. 10.5-14.5% SL).

Clarias pseudoleiacanthus and *C. kapuasensis* are distinguishable from *C. intermedius* and *C. meladerma* with it junior synonym *C. melasoma* by a longer distance between the tip of the occipital process and the base of the first dorsal fin ray (4.5-8.7 *vs*. 1.4-4.5% SL) and by the structure of the anterior side of the pectoral spine with strong and sharp serrae for *C. meladerma* (14-22) and numerous small and pointed serrae for *C. intermedius* (26-46). *Clarias pseudoleiacanthus* and *C. kapuasensis* also differ from *C. intermedius* by a longer predorsal length (28.0-33.7 *vs*. 25.0-28.0% SL). Finally, *C. pseudoleiacanthus* can be distinguished from *C. intermedius* by a longer caudal peduncle depth (7.1-8.6 *vs*. 4.6-6.8% SL), and from *C. meladerma* by a broader vomerine toothplate width (24.4-28.1 *vs*. 19.8-24.4% HL).

Examination of the remaining species *C. olivaceus*, *C. anfractus*, *C. planiceps*, *C. batu*, *C. microstomus*, *C. leiacanthus* with its junior synonyms *C. teijsmanni*, *C. thienemanni*, *C. cataractus* and *C. pulcher* shows that they differ from *C. pseudoleiacanthus* by a longer distance between the occipital process and the base of the first dorsal fin ray (5.9-12.2 vs. 4.5-5.6% SL) and from *C. kapuasensis* by a longer occipital process length (6.8-17.9 vs. 5.2-6.6% HL).

Here again the structure of the anterior side of the pectoral spine is a useful character for distinguishing the two new species from *C. planiceps*, *C. anfractus*, *C. olivaceus* and *C. leiacanthus* (without serrae *vs*. presence of fine to prominent serrae). By contrast, the anterior side of the pectoral spine of *C. batu* and *C. microstomus* is smooth as for the new species. Nevertheless, *C. batu* can be distinguished from the two new species by a slender maximal body depth (11.0-12.0 *vs*. 14.4-18.2% SL) and a longer snout length (26.5-28.4 *vs*. 18.4-25.0% HL), while *C. microstomus* possesses a lower number of gill rakers on the first branchial arch (15-16 *vs*. 17-22) following the data published by Ng (2001).

Clarias pseudoleiacanthus is distinguished from *C. kapuasensis* by a shorter distance between the base of the last dorsal fin ray and the base of the first caudal fin ray (1.2-1.1 *vs*. 1.2-1.7% SL), a shorter distance between the tip of the occipital process and the base of the first dorsal fin ray (4.5-5.6 *vs*. 6.4-8.7% SL), and fewer gill rakers on the first branchial arch (17-19 *vs*. 21-22). The anterior tip of the frontal fontanelle can reach the virtual line connecting the posterior border of eyes in *C. kapuasensis* but never reaches this line in *C. pseudoleiacanthus*.

Finally, we did not use the shape of the male genital papilla proposed by Ng (1999) for distinguishing Southeast Asian *Clarias* because examination of this character revealed that its variation was greatly affected by the maturation condition of the specimens analysed.

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